On the Computation of Star-corrections. By W. H. Finlay, M.A.

Professor Turner's paper in the April number of the *Monthly Notices* leads me to describe a diagram which I tried some years ago for computing star-corrections.

On squared paper a quadrant of a circle, with radius representing 25″, is drawn, and is graduated to every degree by radial lines from the centre A (plate 1). These graduations also represent angles of four minutes of time at A. (Only a few of these lines are shown in the figure, so as to avoid confusion.)

Ax is the initial line for time from 0^h to 6^h; Ay for time from 6^h to 12^h and for declination.

The star-corrections are given by the formulæ

$$\Delta\alpha = f + g \sin (G + \alpha) \tan \delta + h \sin (H + \alpha) \sec \delta$$
$$\Delta\delta = i \cos \delta + g \cos (G + \alpha) + h \cos (H + \alpha) \sin \delta.$$

The first step is to form the sums $(G + \alpha)$ for all the stars observed on any particular day, and with the corresponding value of g as radius describe a quadrant of a circle about A. Let S be the point where the radial line corresponding to a certain star's $(G + \alpha)$ cuts the circle of radius g.

Through S draw MSL, parallel to Ax, to meet the line of the star's declination in L. Then

$$LM = AM \tan \delta = g \sin (G + \alpha) \tan \delta$$

and

$$SM \qquad = g \cos (G + \alpha).$$

After these terms have been obtained for all the stars, the sums $(H + \alpha)$ are to be formed and a circle of radius h drawn. For convenience I shall use the same circle as before on the diagram, and take S as the point where the radial line to $(H + \alpha)$ cuts the circle of radius h.

Take AQ along the declination line of the star and equal to SM. Then

$$AL = AM \sec \delta = h \sin (H + \alpha) \sec \delta$$
$$QR = SM \sin \delta = h \cos (H + \alpha) \sin \delta.$$

The values of $i \cos \delta$ can be easily obtained by drawing a similar circle of radius i on the diagram, or (if i be very small) they can be taken from a little table. The corrections, therefore, are

$$\Delta\alpha = f + LM + AL$$

and

$$\Delta\delta = i \cos \delta + SM + QR.$$

When g is smaller than $3''$ the first circle may be more conveniently described with a radius equal to $10g$, and the resulting values of LM and SM divided by 10. With a paper diagram it is not easy to avoid the formation of $G+a$ and $H+a$ for each star; but if the radial lines were ruled on some semitransparent surface and a graduated circle pivoted beneath it at A, then by turning this circle through an angle G, the values of the lines LM and SM could be read off at once with the argument a.

The chief merit of this diagram is that it gives the value of Δa directly instead of $\Delta a \cos \delta$.

When the declination is very large the lengths ML and AL become unmanageable, but with a scale of $2\frac{1}{2}''$ to the inch there was no difficulty in working to 70° declination. Beyond this point the R.A. correction can be easily obtained from the diagram in the form $\Delta a \cos \delta$, by proceeding in a manner somewhat similar to that described for the declination correction.

With this diagram star-corrections could be read in pretty rapidly; but, owing in great part to the imperfections of home-made scales, the results could not be depended on to within $0''\cdot2$. I therefore abandoned the diagram in favour of the tables described in *Monthly Notices*, vol. l. p. 497. These tables have been since completed, and have been in regular use at the Cape Observatory for the last two years. They are found to effect a saving of quite 33 per cent. in the time taken to compute star-corrections; they present no difficulty in working to quite inexperienced computers, and the results can be relied on to $0''\cdot03$.

The tables might have been compressed: the same value might have been chosen for g_0 and h_0, everything expressed in arc, and the R.A. correction obtained in the form $\Delta a \cos \delta$; but after long consideration I decided on the present form. It is desirable to get the R.A. correction at once in time instead of in arc; even the simple operation of turning arc into time, if repeated four or five thousand times in a year, means delay; so P and Q are tabulated in seconds of time. Up to 60° declination the variations of P and Q are practically uniform through the degree, but beyond that point this is not quite true. The variations given after that are average variations, and consequently there may arise errors of one or two thousandths of a second in allowing for the minutes of the declination. The proportional part of the variation for one degree which corresponds to any given number of minutes is taken at sight from a table.

Beyond 70° declination I have modified the tables. Instead of $g_0 \sin \theta \tan \delta$ and $h_0 \sin \theta \sec \delta$, I have tabulated $g_0 \sin \theta \sin \delta$ and $h_0 \sin \theta$. The sum of P and Q has now to be multiplied by $\sec \delta$. Their variations for a degree are very small, and their values, allowing for the minutes of declination, can be taken straight out.

The tables may also be used for the computation of the effects of precession, aberration, and nutation on micrometrical measures of distance and position-angle.

The formula for precession in distance may be put in the form

$$\frac{\Delta\sigma}{\sigma \sin 1''} = h \cos (\mathrm{H}+\alpha) \cos \delta - i \sin \delta$$
$$= h \cos (\mathrm{H}+\alpha) \sin (90^\circ - \delta) - i \cos (90^\circ - \delta)$$
$$= \mathrm{Q}' (1+y) - \mathrm{I}$$

where Q′ and I are to be taken from the table for declination $= 90^\circ - \delta$.

In position-angle we have

$$\Delta p = g \sin (\mathrm{G}+\alpha) \sec \delta + h \sin (\mathrm{H}+\alpha) \tan \delta$$
$$= g \sin (\mathrm{G}+\alpha) \tan \delta \operatorname{cosec} \delta + h \sin (\mathrm{H}+\alpha) \sec \delta \,.\, \sin \delta$$
$$= 15\, \mathrm{P} (1+x) \operatorname{cosec} \delta + 15\, \mathrm{Q} (1+y) \sin \delta.$$

Cape of Good Hope :
1894 *October* 10.

Note on the Binary Star κ Pegasi (β 989). By T. Lewis, Royal Observatory, Greenwich.

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κ Pegasi	R.A.	$21^h\ 39^m\ 53^s.4$	1895·0
	N.P.D.	$64^\circ\ 58'\ 10''.7$	

The small companion to κ *Pegasi* was noted in 1776 by Sir W. Herschel, and has been frequently measured as Σ 2824.

In 1880 August Mr. Burnham found the large star to be a close double (β 989). In the *Monthly Notices*, 1891 March, he gives all the measures and deduces a period of 11·13 years, thus making it the most rapid binary star known.

He remarks : "The extreme difficulty of measuring so close a pair seems to have deterred other observers, with a single exception, from doing anything with it. . . . It is unfortunate that we have so little to represent the extraordinary motion of this pair. . . . Since I have been at Mount Hamilton I have measured the close pair each year with the 36-inch refractor. During the measures of the past year it was extremely difficult, and was a severe test of the power of the great telescope with the very best atmospheric conditions."

This note naturally induced an inspection with the 28-inch refractor of the Royal Observatory, Greenwich, which showed them distinctly separated with a power of 1030, and our measures appear to confirm the remarkably short period.